



US-PAT-NO: 5997745  
DOCUMENT-IDENTIFIER: US 5997745 A

TITLE: Method for producing high purity water using triple pass reverse osmosis  
TFRG

DATE-ISSUED: December 7, 1999

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Tonelli; Anthony A	Burlington			CAX
Deutschmann; Ake	Burlington			CAX
Wesno; Susan L	Burlington			CAX

US-CL-CURRENT: 210/652; 210/180, 210/195.2, 210/639, 210/746, 210/85, 210/85.2,  
95/51

Full	Title	Citation	Front	Review	Classification	Date	Reference	Claims	KWIC	Draw Desc	Image
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## 4. Document ID: US 5925255 A

L4: Entry 4 of 8

File: USPT

Jul 20, 1999

US-PAT-NO: 5925255  
DOCUMENT-IDENTIFIER: US 5925255 A

TITLE: Method and apparatus for high efficiency reverse osmosis operation

DATE-ISSUED: July 20, 1999

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Mukhopadhyay; Debasish	Palo Alto	CA	94306	

US-CL-CURRENT: 210/652; 210/638, 210/651, 210/661, 210/663

Full	Title	Citation	Front	Review	Classification	Date	Reference
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KWIC	Draw Desc	Image
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## 5. Document ID: US 5858240 A

L4: Entry 5 of 8

File: USPT

Jan 12, 1999

US-PAT-NO: 5858240  
DOCUMENT-IDENTIFIER: US 5858240 A

TITLE: Nanofiltration of concentrated aqueous salt solutions

DATE-ISSUED: January 12, 1999

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Twardowski; Zbigniew	Burnaby			CAX
Ulan; Judith G.	Richmond			CAX

US-CL-CURRENT: 210/652; 210/639, 210/641, 210/651, 210/653, 210/835

Full	Title	Citation	Front	Review	Classification	Date	Reference
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## 6. Document ID: US 5458781 A

L4: Entry 6 of 6

File: USPT

Oct 17, 1995

US-PAT-NO: 5458781

DOCUMENT-IDENTIFIER: US 5458781 A

TITLE: Bromide separation and concentration using semipermeable membranes

DATE-ISSUED: October 17, 1995

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Lin; Kaung-Far	Baton Rouge	LA		

US-CL-CURRENT: 210/651; 210/641, 210/652, 423/504

Full	Title	Citation	Front	Review	Classification	Date	Reference
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KVMC	Draw Desc	Image
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## 7. Document ID: US 5158683 A

L4: Entry 7 of 8

File: USPT

Oct 27, 1992

US-PAT-NO: 5158683

DOCUMENT-IDENTIFIER: US 5158683 A

TITLE: Bromide separation and concentration using semipermeable membranes

DATE-ISSUED: October 27, 1992

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Lin; Kaung-Far	Baton Rouge	LA		

US-CL-CURRENT: 210/651; 210/652, 423/504

Full	Title	Citation	Front	Review	Classification	Date	Reference
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KVMC	Draw Desc	Image
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## 8. Document ID: US 4927540 A

L4: Entry 8 of 8

File: USPT

May 22, 1990

US-PAT-NO: 4927540

DOCUMENT-IDENTIFIER: US 4927540 A

TITLE: Ionic complex for enhancing performance of water treatment membranes

DATE-ISSUED: May 22, 1990

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Wessling, Ritchie A.	Midland	MI		
Whipple, Sharon S.	Sanford	MI		
Fibiger, Richard F.	Midland	MI		

US-CL-CURRENT: 210 638, 210 490, 210 500.27, 210 511.34, 210 511.37, 210 511.38,  
210 654

Full	Title	Citation	Front	Review	Classification	Date	Reference
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## Terms

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FIELD: 2550

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DOCUMENT-IDENTIFIER: US 6258276 B1  
TITLE: Microporous Membranes and uses thereof

**ESPR:** Membranes are used, for instance, in separation processes as selective barriers that allow certain chemical species to pass, i.e., the permeate, while retaining other chemical species, i.e., the retentate. Membranes are used in many applications, for example as biosensors, heparinized surfaces, facilitated transport membranes utilizing crown ethers and other carriers, targeted drug delivery systems including membrane-bound antigens, catalyst-containing membranes, treated surfaces, sharpened resolution chromatographic packing materials, narrow band optical absorbers, and in various water treatments which involve removal of a solute or contaminant, for example, dialysis, electrodialysis, microfiltration, ultrafiltration, reverse osmosis, nanofiltration and in electrolysis and in fuel cells and batteries.

DEPS: Microporous polypropylene or polyethylene membranes which have in situ polymerized vinylpyridine and which are cross-linked with about 0.25 to about 1 wt % by weight of the total monomers by divinylbenzene are particularly useful in pressure driven water treatment, i.e. reverse osmosis or nanofiltration cations in preference to monovalent reject multivalent cations in preference to monovalent cations. By varying the degree of properties of the cross-linking, the membrane may be modified to be specific for specific applications. Such membranes are considered novel and constitute one aspect of the invention.

DEPR: The rejection of salts containing monovalent cations, for example,  $\text{Na}^+$ , is subsequently lower than rejection of salts with multivalent cations, for example,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ . Charged organic materials, such as organic acids and salts, also are rejected by the membranes, while relatively large non-ionic organic molecules, such as sucrose, have low rejections by the membranes. The ability of the membranes to function at such ultra-low pressures and their distinctive pattern of separations distinguishes the membranes from other commercially-available nanofiltration or reverse osmosis membranes, which function only effectively at higher pressures.

DEPR: Existing commercial membranes used for water softening are limited by an excessive and indiscriminate rejection of all dissolved species and this is particularly true with thin-film composite membranes, commercial examples being low-pressure nanofiltration membranes available from FilmTec and Fluid Systems. Other nanofiltration membranes which have been developed specifically for removal of organic materials from water, generally humic acid derivatives, exhibit a low removal of ions, including calcium. The recommended operating pressures for commercially available low pressure nanofiltration membranes are higher than those found to be sufficient for the invented membranes.

DEPR: Charged membranes are used in a wide variety of electrochemical applications including electrodialysis, electrolysis, fuel cells and battery separators. A key feature of membranes for these applications are high ion-exchange capacities, low water transport, low electrical resistance, and good selectivity in terms of the transport of ions of different charge type (cations versus anions).

DEFINITION:

TABLE 1 Characteristics of thin-film composite TF nanofiltration membranes  
 Rated Permeability Operating Flux at Rated L/m<sup>2</sup> h KPa Pressure kPa Pressure  
 L/m<sup>2</sup> h (gpd/sq ft) Membrane Material (psig) (gpd/sq ft) (psig) NFR<sup>1</sup>.sup. 1  
 modified 483 (70) 37 (22) 0.118 0.48 aromatic polyamide TFCS<sup>2</sup>.sup. 2 modified  
 522 (80) 26 (15) 0.049 0.20 aromatic polyamide NTR7450<sup>3</sup>.sup. 3 sulfonated Ar  
 143 (93) 55 (32) 0.106 0.43 polyether sulfone NTR7410<sup>3</sup>.sup. 3 sulfonated Ar  
 496 (292) 0.185 0.75 polyether sulfone .sup. 1 FilmTec, Minneapolis, Minn.  
 .sup. 2 Fluid Systems, San Diego, CA. .sup. 3 Nitto Denko from Hydranautics,  
 San Diego, CA.

DETAIL:  
 TABLE 1 Characteristics of thin-film composite TF nanofiltration membranes  
 Rated Permeability Operating Flux at Rated L/m<sup>2</sup> h KPa Pressure kPa Pressure  
 L/m<sup>2</sup> h (gpd/sq ft) Membrane Material (psig) (gpd/sq ft) (psig) NFR<sup>1</sup>.sup. 1  
 modified 483 (70) 37 (22) 0.118 0.48 aromatic polyamide TFCS<sup>2</sup>.sup. 2 modified  
 522 (80) 26 (15) 0.049 0.20 aromatic polyamide NTR7450<sup>3</sup>.sup. 3 sulfonated Ar  
 143 (93) 55 (32) 0.106 0.43 polyether sulfone NTR7410<sup>3</sup>.sup. 3 sulfonated Ar  
 496 (292) 0.185 0.75 polyether sulfone .sup. 1 FilmTec, Minneapolis, Minn.  
 .sup. 2 Fluid Systems, San Diego, CA. .sup. 3 Nitto Denko from Hydranautics,  
 San Diego, CA.

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**Search Results - Record(s) 1 through 6 of 6 returned****1. Document ID: US 6258276 B1**

L8: Entry 1 of 6

File: USPT

Jul 10, 2001

US-PAT-NO: 6258276

DOCUMENT-IDENTIFIER: US 6258276 B1

TITLE: Microporous membranes and uses thereof

DATE-ISSUED: July 10, 2001

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Mika; Alicja M.	Hamilton			CAX
Childs; Ronald F.	Dundas			CAX
Dickson; James M.	Hamilton			CAX

US-CL-CURRENT: 210/638; 210/641, 210/651, 210/654

Full	Title	Citation	Front	Review	Classification	Date	Reference
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**2. Document ID: US 5858240 A**

L8: Entry 2 of 6

File: USPT

Jan 12, 1999

US-PAT-NO: 5858240

DOCUMENT-IDENTIFIER: US 5858240 A

TITLE: Nanofiltration of concentrated aqueous salt solutions

DATE-ISSUED: January 12, 1999

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Twardowski; Zbigniew	Burnaby			CAX
Ulan; Judith G.	Richmond			CAX

US-CL-CURRENT: 210/652; 210/639, 210/641, 210/651, 210/653, 210/805

Full	Title	Citation	Front	Review	Classification	Date	Reference
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KWIC	Draw Desc	Image
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**3. Document ID: US 5587083 A**

L8: Entry 3 of 6

File: USPT

Dec 24, 1997

US-PAT-NO: 5547163  
DOCUMENT-IDENTIFIER: US 5547163 A

TITLE: Nanofiltration of concentrated aqueous salt solutions

DATE-ISSUED: December 24, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Twarcowski, Zbigniew	Burnaby			CAN

US-CL-CURRENT: 210/652; 211/651; 211/653

Full	Title	Citation	Front	Review	Classification	Date	Reference
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KWIC	Draw Desc	Image
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4. Document ID: US 5522995 A

LS Entry 4 of 6

File: USPT

Jun 4, 1996

US-PAT-NO: 5522995  
DOCUMENT-IDENTIFIER: US 5522995 A

TITLE: Process for recovering organic acids from aqueous salt solutions

DATE-ISSUED: June 4, 1996

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Cockrem, Michael C. M.	Madison	WI	53705	

US-CL-CURRENT: 210/637; 210/259; 210/654

Full	Title	Citation	Front	Review	Classification	Date	Reference
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5. Document ID: US 5147553 A

LS Entry 5 of 6

File: USPT

Sep 15, 1992

US-PAT-NO: 5147553  
DOCUMENT-IDENTIFIER: US 5147553 A

TITLE: Selectively permeable barriers

DATE-ISSUED: September 15, 1992

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Waite, Warren A.	Burlington	MA		

US-CL-CURRENT: 210/654; 210/490; 210/500.34; 427/245

Full	Title	Citation	Front	Review	Classification	Date	Reference
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6 Document ID: US 5118424 A

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DATE-ISSUED: June 2, 1992

NAME

CITY

STATE

ZIP CODE

## CONCLUSIONS

Zurich

**Figure 1**

McRae; Wayne A.

72-CL-CURRENT: 210,653; 210,490; 210,500.21; 210,500.28; 210,500.30; 210,500.42; 210,500.42; 210,500.43; 210,654; 264,45.2

| Full | Title | Citation | Front | Review | Classification | Date | Reference | KMCC | Draw Desc | Image |
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| USPT           | 17 and charge                                  | 6                | <u>L8</u>       |
| USPT           | 16 and polyamide                               | 11               | <u>L7</u>       |
| USPT           | nanofiltration and tfc                         | 14               | <u>L6</u>       |
| USPT           | 14 and nf                                      | 5                | <u>L5</u>       |
| USPT           | 11 and nanofiltration and polyamide and charge | 8                | <u>L4</u>       |
| USPT           | 11 and nanofiltration and tfc                  | 4                | <u>L3</u>       |
| USPT           | 11 and hirose                                  | 12               | <u>L2</u>       |
| USPT           | 210/638  | 1039             | <u>L1</u>       |